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10/765,301	01/27/2004	Terrence C. Leslie	303.860US1	9293

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EXAMINER	
LANDAU, MATTHEW C	
ART UNIT	PAPER NUMBER
2815	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/20/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/765,301	LESLIE, TERRENCE C.	
	Examiner	Art Unit	
	Matthew Landau	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 November 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-40 and 71-73* is/are pending in the application.

4a) Of the above claim(s) *5-7,21-23,28 and 29* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,8-20,24-27,30-40 and 71-73* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 January 2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *11/9/06*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Claims 5-7, 21-23, 28, and 29 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected species, there being no allowable generic or linking claim.

Drawings

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "abrupt p-n junction" (claim 72) must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will

be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 12-15, 19, 20, and 72 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Regarding claim 12, the limitation "the first source/drain region extends horizontally around the selective epitaxy mesa" (in conjunction with the limitations of claim 1) is not sufficiently supported by the originally filed application. Although claim 12 is an original claim, claim 1 has been amended throughout the prosecution. The above limitation reads on the embodiment shown in Figure 4B. However, the embodiment shown in Figure 4B has doped regions 37 formed by horizontal diffusion (see page 11, lines 21-23). Since the doped regions are formed in this manner, they cannot have a "laterally non-graded dopant profile" as required by claim 1. Therefore, the above limitation constitutes new matter. Note that claim 19 has the same problem.

Regarding claim 72, the limitation "the region of the selective epitaxy mesa adjacent to the buried conductive pate comprises at least one abrupt p-n junction" is not sufficiently supported by the originally filed application. There is no disclosure of a mesa having a p-n junction. The specification describes having an undoped channel (body), meaning there would be no p-n junction between the source/drain regions and the channel. Therefore, the above limitation constitutes new matter.

Claim Objections

Claims 2 and 33 are objected to because of the following informalities:

Regarding claim 2, the limitation "wherein selective epitaxy" should be changed to "wherein the selective epitaxy".

Regarding claim 33, the limitation "electrically communication" should be changed to "electrical ~~electrically~~ communication". Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-4, 8-11, 16-18, 24-27, and 71-73 are rejected under 35 U.S.C. 102(b) as being anticipated by Fitch et al. (US Pat. 5,451,538, hereinafter Fitch).

Regarding claims 1 and 9, Figure 10 of Fitch discloses a substrate 12; a vertical access device including a selective epitaxy mesa (28, 30, 32, and 34), wherein the selective epitaxy mesa comprises a doped region 28 being in contact with a buried conductive path 14 laterally, the doped region of the selective epitaxy mesa includes a laterally non-graded dopant profile consisting essentially of dopant of one conductivity type (col. 4, lines 42-48); and a storage device 69 on the selective epitaxy mesa. Note that Figure 4 of Fitch discloses that layers 28, 30, 32, and 34 are selectively formed by epitaxial growth techniques (col. 4, lines 30-36). Also note that Fitch discloses region 14 is the bit line (col. 7, lines 46-48), and therefore inherently has a conductive path. Region 28 can be considered in contact with conductive path 14 laterally since there is a horizontal junction between the two regions. In other words, the contact portion between the two regions extends in a lateral direction. Note that Applicant has not explicitly defined the phrase "in contact with...laterally" in a manner that would preclude this interpretation.

Regarding claim 2, Figure 10 of Fitch discloses the selective epitaxy mesa (28, 30, 32, and 34) includes a bottom source/drain (S/D) 28 and a top S/D 32/34, and a conductive body 30 separating the bottom S/D from the top S/D.

Regarding claim 3, Fitch discloses the bottom S/D region 28 is an in situ doped region (col. 4, lines 43-48).

Regarding claim 4, Fitch discloses the top S/D region 32/34 is an in situ doped region (col. 5, lines 3-10).

Regarding claim 8, Figure 10 of Fitch discloses the access device is free from a shallow trench isolation layer.

Regarding claim 10, Fitch discloses the substrate 12 includes silicon (col. 3, line 10), and wherein the selective epitaxy mesa includes silicon (col. 4, lines 36-41).

Regarding claim 11, Figure 10 of Fitch discloses the access device includes a body 30, a first S/D region 28, a gate 18 and a second S/D region 32/34, wherein the body extends between the first S/D region and the second S/D region, and wherein the first S/D region and the second S/D region are each a selective epitaxy doped region of the selective epitaxy mesa (col. 4, lines 43-48 and col. 5, lines 3-10).

Regarding claims 16 and 26, Figure 10 of Fitch discloses a substrate 12; an electrical signal line (bit line) 14 (col. 7, lines 46-48) on the substrate; an access device including: a selective epitaxy mesa (28/30/32/34) formed on and extending outwardly from the substrate, the selective epitaxy mesa including a first S/D region 28 adjacent the substrate and in electrical communication with the electrical signal line, wherein the first S/D region 28 includes a lateral non-graded dopant profile consisting essentially of dopant atoms of one conductivity type (col. 4, lines 43-48), the selective epitaxy mesa further including a body 30 extending vertically from the first S/D region 28, an insulator 22 on the body, and a gate 18 on the insulator; and a storage device 69 on the selective epitaxy mesa.

Regarding claim 17, Figure 10 of Fitch discloses the electrical signal line14 has a first height (depth), and wherein the first S/D region 28 has a second height (thickness) equal to or less than the first height.

Regarding claim 18, Figure 10 of Fitch discloses the selective epitaxy mesa (28/30/32/34) cantilevers upwardly from the substrate, and wherein the selective epitaxy mesa includes an end, remote from the substrate, forming a second S/D region 32/34.

Regarding claim 24, Figure 10 of Fitch discloses the first S/D region 28 is adapted to electrically communicate with a column address decoder through a buried bit line 14.

Regarding claim 25, Figure 10 of Fitch discloses the second S/D region 23/34 is adapted to electrically communicate with the storage device.

Regarding claim 27, Figure 6 of Fitch discloses the insulator 22 surrounds the body 30, and wherein the gate 18 surrounds the insulator such that the gate effects electrical conductivity of the body from more than one angle.

Regarding claim 71, Figure 10 of Fitch discloses the selective epitaxy mesa includes a region of polycrystalline silicon (col. 5, lines 44-46).

Regarding claims 72 and 73, Figure 10 of Fitch discloses the region 28 of the selective epitaxy mesa adjacent to the buried conductive path comprises at least one abrupt p-n junction (the junction between region 30 and region 28). Region 28 is abruptly doped.

Claims 1-4, 8-11, 16-18, 24, 25, 72 and 73 are rejected under 35 U.S.C. 102(b) as being anticipated by Maeda et al. (US Pat. 6,303,425, hereinafter Maeda).

Regarding claims 1 and 9, Figures 2, 13-15, and 33 of Maeda disclose a substrate 1; an access device including a selective epitaxy mesa 11/12/13 formed on and extending outwardly from the substrate, wherein the selective epitaxy mesa comprises a doped region 11 being in contact with a buried conductive path 31/30 (Fig. 33) laterally, the doped region of the selective epitaxy mesa includes a laterally non-graded dopant profile consisting essentially of dopant of one conductivity type; and a storage device 26/21/22 (capacitor) on the selective epitaxy mesa. Note that in the embodiment of Fig. 33, when the selective epitaxy mesa is grown, the doped region 11 will laterally contact region 31, which is in contact with region 30. Region 30 is equivalent to region 24 of Fig. 2, and both are the bit line (BL) (buried conductive path) (col. 14, lines 20-24 and col. 19, line 25). Region 31 can be considered part of the buried conductive path since it is electrically connected to the BL 30. Also note that region 11 (region 6a) is doped using ion-implantation and diffusion (col. 17, lines 14-20). Since the implantation/diffusion occurs in from the vertical direction, the dopant profile will not be graded in the lateral direction.

Regarding claims 2 and 11, Figures 2 and 13-15 of Maeda disclose the selective epitaxy mesa 11/12/13 (or 6a/12/6b as shown in Fig. 14) includes a bottom (first) S/D region 11(or 6a) and a top (second) S/D region 13(or 6b), and wherein the selective epitaxy mesa further includes a conductive body 12 separating the bottom S/D from the top S/D region, and wherein the first S/D and the second S/D region are each a selective epitaxy doped region of the selective epitaxy mesa (col. 17, lines 7-20).

Regarding claim 3, the limitation "the bottom source/drain region is an in situ doped region" is merely a product-by-process limitation that does not structurally distinguish the claimed invention over the prior art. The patentability of a product does not depend on its

method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process. *In re Thorpe*, 227 USPQ 964, 966.

Regarding claim 4, the limitation "the top source/drain region is an in situ doped region" is merely a product-by-process limitation that does not structurally distinguish the claimed invention over the prior art.

Regarding claim 8, Figure 2 of Maeda discloses the access device is free from a shallow trench isolation layer.

Regarding claim 10, Figure 2 of Maeda discloses the substrate 1 includes silicon (col. 14, lines 18-20), and wherein the selective epitaxy mesa includes silicon (col. 17, lines 7-10).

Regarding claim 16, Figures 2, 13-15, and 33 of Maeda disclose a substrate 1; an electrical signal line (bit line) 30/31 on the substrate; an access device including: a selective epitaxy mesa 11/12/13 (or 6a/12/6b as shown in Fig. 14) formed on and extending outwardly from the substrate, the selective epitaxy mesa including a first S/D region 11 (or 6a) adjacent the substrate and in electrical communication with the electrical signal line, wherein the first S/D region includes a lateral non-graded dopant profile consisting essentially of dopant atoms of one conductivity type (col. 4, lines 43-48), the selective epitaxy mesa further including a body 12 extending vertically from the first S/D region, an insulator 4 on the body, and a gate 25 on the insulator; and a storage device 26/21/22 on the selective epitaxy mesa. Note that in the embodiment of Fig. 33, when the selective epitaxy mesa is grown, the doped region 11 will laterally contact region 31, which is in contact with region 30. Region 30 is equivalent to region 24 of Fig. 2, and both are the bit line (BL) (buried conductive path) (col. 14, lines 20-24 and col.

19, line 25). Region 31 can be considered part of the buried conductive path since it is electrically connected to the BL 30. Also note that region 11 (region 6a) is doped using ion-implantation and diffusion (col. 17, lines 14-20). Since the implantation/diffusion occurs in from the vertical direction, the dopant profile will not be graded in the lateral direction.

Regarding claim 17, Figures 2 and 33 of Maeda discloses the BL 30/31 has a first height (combined height of regions 30 and 31), and wherein the first S/D region 11 (or 6a) has a second height equal to or less than the first height.

Regarding claim 18, Figure 2 of Maeda discloses the selective epitaxy mesa 11/12/13 cantilevers upwardly from the substrate, and wherein the selective epitaxy mesa includes an end, remote from the substrate, forming a second S/D region 13 (or 6b of Figure 14).

Regarding claim 24, Figure 2 of Maeda discloses the first S/D region 11 is adapted to electrically communicate with a column address decoder through a buried bit line 24.

Regarding claim 25, Figure 2 of Maeda discloses the second S/D region 13 is adapted to electrically communicate with the storage device.

Regarding claims 72 and 73, Figure 2 of Maeda discloses the region 11 of the selective epitaxy mesa adjacent to the buried conductive path comprises at least one abrupt p-n junction (the junction between region 11 and region 12). Region 11 is abruptly doped.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Maeda in view of Kurjanowicz et al. (US PGPub 2002/0131291, hereinafter Kur).

Regarding claim 30, Maeda does not disclose the electrical signal line 24 includes titanium. Kur discloses using titanium silicided wordlines (paragraph [0006], last 5 lines). In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Maeda by included a layer of titanium silicide on the signal line for the purpose of reducing the effective resistance (see last 5 lines in paragraph [0006] of Kur).

Claims 31-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fitch in view of Chew et al. (US Pat. 6, 518,622, hereinafter Chew).

Regarding claims 31 and 32, Figure 10 of Fitch discloses a vertical, selective epitaxy body (28/30/32/34) extending from a horizontal substrate 12; a first doped region 28 in the body adjacent the substrate, the first doped region laterally contacts a buried bit line 14 (col. 7, lines 46-48), and includes a laterally non-graded dopant profile consisting essentially of dopant of one conductivity type (col. 4, lines 42-48); a second doped region 32/34 in the body remote from the substrate; an intermediate region 30 (channel region) between the first doped region and the

second doped region; and a gate 18 at least partially surrounding the intermediate region. Region 28 can be considered in laterally contacting the bit line 14 since there is a horizontal junction between the two regions. In other words, the contact portion between the two regions extends in a lateral direction. Note that Applicant has not explicitly defined the phrase "laterally contacts" in a manner that would preclude this interpretation. The difference between Fitch and the claimed invention is the intermediate region (channel region) is undoped. Figure 6 of Chew discloses a vertical access device with an undoped, epitaxial channel region 605 (col. 4, lines 30-34). In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Fitch by using an undoped channel region for the purpose of simplifying the production process (by eliminating the doping step).

Regarding claim 33, Figure 10 of Fitch discloses the first doped region 28 is in electrical communication with the bit line 14.

Regarding claim 34, Figure 10 of Fitch discloses the gate 18 is adapted to be in electrical communication with a word line 18 (col. 7, lines 45 and 46). Note that the portion of the word line 18 adjacent to the dielectric layer 22 functions as the gate.

Regarding claims 35-40, Figures 6 and 10 of Fitch discloses the gate 18, overlies about all of the surface area of the intermediate region 30, the gate is generally annular and extends completely around the body, and the vertical epitaxy body is cylindrical. Since the first doped region is part of the epitaxy body, it is also cylindrical.

Claims 31-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maeda in view of Chew.

Regarding claims 31 and 32, Figures 2, 13-15, and 33 of Maeda disclose a vertical, selective epitaxy mesa 11/12/13 (or 6a/12/6b) extending from a horizontal substrate 1/201/24; a first doped region 11 (or 6a) in the body adjacent the substrate, the first doped region laterally contacts a buried BL 30/31, and includes a laterally non-graded dopant profile consisting essentially of dopant of one conductivity type; a second doped region 13 (6b) in the body remote from the substrate; and intermediate region 12 (channel) between the first and second doped regions; and a gate 25 at least partially surrounding the intermediate region. Note that in the embodiment of Fig. 33, when the selective epitaxy mesa is grown, the doped region 11 will laterally contact region 31, which is in contact with region 30. Region 30 is equivalent to region 24 of Fig. 2, and both are the bit line (BL) (buried conductive path) (col. 14, lines 20-24 and col. 19, line 25). Region 31 can be considered part of the buried conductive path since it is electrically connected to the BL 30. Also note that region 11 (region 6a) is doped using ion-implantation and diffusion (col. 17, lines 14-20). Since the implantation/diffusion occurs in from the vertical direction, the dopant profile will not be graded in the lateral direction. The difference between Maeda and the claimed invention is the intermediate (channel) region is undoped. The difference between Fitch and the claimed invention is the intermediate region (channel region) is undoped. Figure 6 of Chew discloses a vertical access device with an undoped, epitaxial channel region 605 (col. 4, lines 30-34). In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the

invention of Fitch by using an undoped channel region for the purpose of simplifying the production process (by eliminating the doping step).

Regarding claim 33, Figures 2 and 33 of Maeda disclose the first doped region 11 is adapted to be in electrical communication with the BL 30/31 (or 24).

Regarding claim 34, Figure 2 of Maeda discloses the gate 25 is adapted to be in electrical communication with a word line 25. Note that the portion of the word line 25 adjacent to the dielectric layer 4 functions as the gate.

Regarding claims 35-40, Figures 2 and 3 of Maeda disclose the gate 25, overlies about all of the surface area of the intermediate region 12, the gate is generally annular and extends completely around the body, and the vertical epitaxy body is cylindrical. Since the first doped region is part of the epitaxy body, it is also cylindrical.

Response to Arguments

Applicant's arguments filed October 11, 2006 have been fully considered but they are not persuasive.

Applicant argues "From Fig. 10 of Fitch, it can be seen clearly that, in contrast to the amended claim 1, "drain electrode 28" of Fitch does not laterally contact with "diffusion 14" (the alleged buried conductive path)". As explained in the above rejection, region 28 of Fitch can be considered to laterally contact region 14 since there is a horizontal junction between the two regions. In other words, the contact portion between the two regions extends in a lateral

direction. Note that Applicant has not explicitly defined the phrase "in contact with...laterally" in a manner that would preclude this interpretation. Applicant further argues that "Applicant cannot find any part of Fitch teaching that "drain electrode 28" includes a laterally non-graded dopant profile consisting essentially of dopant of one conductivity type, which is positively recited in amended claim 1". However, Fitch teaches region 28 is doped in-situ (col. 4, lines 37-59). Therefore, the region 28 will consist essentially of dopant of one conductivity type, and will have a laterally non-graded dopant profile. It is considered in-situ doping will inherently have a laterally non-graded dopant profile. If it is not inherent, then this limitation would constitute new matter since the originally filed application does not specifically teach a laterally non-graded dopant profile. If it is inherent in Applicant's specification, then it must also be inherent in the disclosure of Fitch.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew C. Landau whose telephone number is (571) 272-1731.

The examiner can normally be reached from 8:30 AM - 5:30 PM. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone numbers for the organization where this application or proceeding is assigned are (571) 273-8300 for regular communications and (571) 273-8300 for After Final communications.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should any questions arise regarding access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Matthew C. Landau

February 14, 2007